SPECIAL ARTICLE

Intermediate Respiratory Intensive Care Units: Definitions and Characteristics

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Introduction

Pulmonary and intensive care medicine are specialties that have developed along separate lines in Spain, owing to the following circumstances, among others[1]:

1. When intensive care began in Spain, pulmonary physicians in this country were still rooted in the study of tuberculosis and they did not have a strategic vision of the future. The situation was radically different in cardiology, where specialists asked for and received responsibility for coronary care units.

2. Historically, pneumologists have expressed little interest in assuming the care of critically ill respiratory disease patients.

3. Specialists in intensive care medicine have understandably defended the scope of their specialty and resisted intrusion by outsiders.[2]

The current situation is quite different. On the one hand, the boards of directors of societies devoted to respiratory medicine have shown growing interest in the severely ill patient. This is true both for the Respiratory Intensive Care Assembly of the European Respiratory Society (ERS) and for the Respiratory Failure and Sleep Disorders Assembly of the Spanish Society of Pulmonology and Thoracic Surgery (SEPAR). There is also a trend toward openness between European and Spanish intensive care specialists and respiratory medicine specialists, reflected in joint consensus papers, in the employment of pneumologists by intensive care units (ICUs), and in a generally more open attitude, probably generated by problems related to the aging of medical staff. Finally, the National Commission for Pneumology in Spain has revised resident training programs, placing great emphasis on preparation for critical respiratory care in the new national postgraduate education plan.

A look at the training curriculum reveals the scarce interest in critical care medicine that has been typical for pneumology. The most recent stipulations on the accreditation of teaching hospitals[3] specifies merely that a department responsible for education must have noninvasive ventilation (NIV) therapy available and have an intensive care unit at its disposal. The training plan still in affect hardly contemplates preparation for respiratory intensive care.[4]

The recent recommendations by the ERS working group composed of specialists in pneumology, anesthesiology and intensive care medicine[5] establishes 5 levels of care for critical patients and explains why it would be easy for pneumologists to adapt to caring for one of the levels (Table). It also describes the obstacles to the integration of pneumologists, among which is the lack of inclusion of pneumology in the European critical medicine development plan. One ERS document does propose a model for incorporating pneumologists into the care of the critically ill patient (Figure). Intermediate respiratory intensive care units (RICUs) have a particularly important role in this model.

The board of directors of SEPAR constituted a working group comprised of pneumologists who are familiar with NIV and expert in the care of critically ill respiratory patients. The aim of the working group was to study the situation of these units in Spain and develop a document setting out definitions and needs.

TABLE
Levels of Care Needed by Severely Ill Respiratory Patients[5]

Level 0	Patients whose needs can be met through normal ward care
Level 1	Patients at risk of deterioration in their condition and those recently relocated from higher levels of care
Level 2	Patients requiring support for a single failing organ system or postoperative care, and those "stepping down" from higher levels of care
Level 3	Patients requiring advanced respiratory support alone or basic respiratory support together with support of at least 2 organ systems

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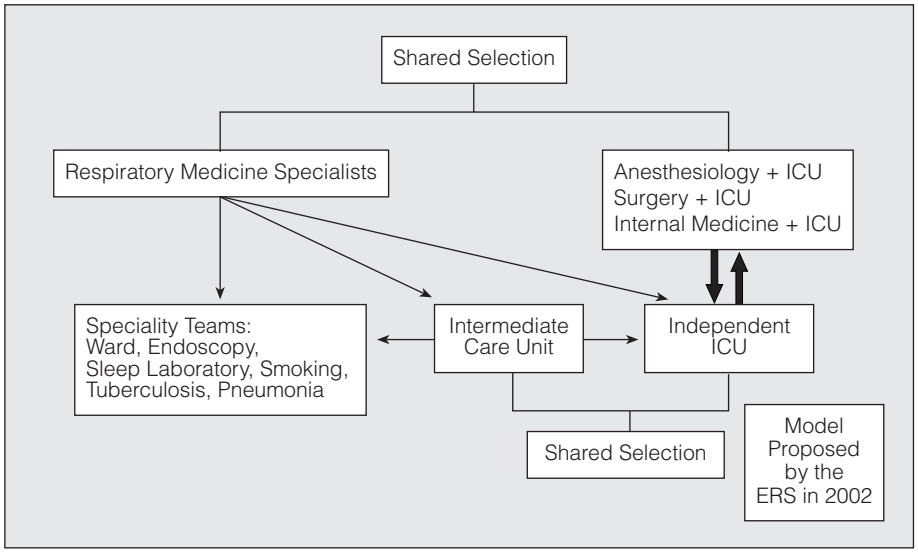

Figure. Model for involving respiratory medicine specialists in the care of the critically ill patient, as proposed by the European Respiratory Society (ERS)[5] ICU indicates intensive care unit.

Definition of Intermediate RICUs and Rationale

An intermediate RICU or noninvasive respiratory care unit is an area for monitoring and treating patients with acute or exacerbated respiratory failure caused by a disease that is primarily respiratory. The essential aim is adequate and appropriate cardiorespiratory monitoring and/or treatment of insufficiency by NIV. A RICU also provides continuous monitoring of patients after thoracic surgery or of those undergoing invasive mechanical ventilation (IMV) through a tracheostomy and treats critical patients whose weaning from IMV is difficult. NIV or noninvasive monitoring techniques should be the main therapeutic approaches of such a unit.

A RICU is designed to care for respiratory patients whose illness is at a level of severity that is intermediate between that which requires ICU facilities and that which can be managed on a conventional ward. The first paper that called for RICUs and described their functions proposed 2 purposes: monitoring severely ill respiratory patients noninvasively and providing better weaning from mechanical ventilation.[6] Such units have received various names but the activities of all of them can be summarized as follows: *a)* care of patients requiring NIV because of acute or exacerbated respiratory insufficiency; *b)* care of patients discharged from an ICU who need a period of intermediate vigilance; *c)* prolonged weaning of tracheostomized patients; and *d)* care of thoracic surgery patients if the unit provides a mixture of medical and postoperative care. The following arguments are used to justify the existence of RICUs: *a)* they need fewer resources for patients who otherwise would need ICU care or who would be poorly served by admission to a conventional care ward; *b)* they can handle patients with chronic obstructive pulmonary disease (COPD) whose weaning from artificial ventilation takes longer; *c)* the NIV needed by many patients is available; and *d)* the cost-effectiveness ratio of NIV is fully demonstrated.

Provision of NIV is and should be the main rationale for the establishment of RICUs. NIV has proven effective for treating the exacerbated hypercapnic respiratory insufficiency that develops in COPD[7,8] and in certain acutely ill and nonhypercapnic patients (those with acute pulmonary edema, immunosuppression, or who have undergone thoracic surgery). It is also effective in the artificial ventilation of patients with chronic respiratory diseases.[9] In all such cases, NIV effectively prevents nosocomial respiratory infection, which is one of the most common and serious complications of IMV.

A key argument in favor of intermediate RICUs arises from the consideration that many patients in traditional ICUs do not need or do not benefit from the high level of staff care and monitoring provided there. Nevertheless, these patients could not be adequately managed on a conventional hospital ward; therefore a step-down RICU is the appropriate place to treat them. Since that first paper, some authors have based the rationale for RICUs on the relief of ICU overload in a way that would not be detrimental to quality of care for the respiratory patient.

Up to 40% of patients admitted to ICUs are thought not to need IMV. Likewise, only 40% of patients with acute respiratory failure resulting from a pulmonary disease need IMV.[10-14] One study of 99 Italian ICUs found that COPD was the most common underlying chronic disease among patients in such units and that the most common reason for admission was need for cardiopulmonary monitoring.[15]

That study suggested that there is excessive or inappropriate utilization of available ICU resources to perform functions such as monitoring or treating

patients with exacerbated chronic respiratory insufficiency for whom IMV is not indicated. Moreover, when patients do need IMV, up to 60% of ventilation time is part of the weaning process.[15-18]

Several studies have found that transferring ICU patients to a RICU or admitting patients with low probability of needing intensive care directly to a RICU can be an effective way of reducing costs and improving the utilization of general ICUs.[19] It has been demonstrated that 40% of patients in medical ICUs and 30% of those in surgical ICUs are admitted only for continuous monitoring 24 hours a day and that these patients do not receive therapeutic interventions there. The mission of a RICU would go beyond reducing health care costs: it would encompass the enhancement of efficient use of existing ICU resources. Correct use of RICUs frees ICU beds so that they can be used more appropriately. Intermediate RICUs also prevent situations of insufficient care given to patients placed on conventional wards because they could not be admitted to a general ICU.[12,19,20]

The aforementioned considerations justify creating RICUs, whose main objective is to offer better quality health care with *a)* a smaller staff mainly of nurses and assistants and less use of technical resources[19]; *b)* better utilization of ICU resources, which can be reserved for patients who really need them[20]; and *c)* the possibility of discharging patients from the ICU earlier if they have overcome the acute stage of disease but still require medical or nursing care, or NIV to facilitate weaning (care that can not be offered on conventional hospital wards).

In addition to factors related to health care resources, other advantages of intermediate RICUs should be considered, such as their provision of greater patient privacy, enhanced well-being because of the use of less equipment, less environmental disturbance (from noises and lights), and more flexible visiting hours for families. All those advantages make the RICU the ideal place for certain types of patients, contributing to their improvement and facilitating hospital discharge, particularly for those who will then use respiratory support devices at home.[21,22]

In summary, intermediate RICUs can be said to reduce hospital costs, reduce mean ICU length of stay without increasing overall time of hospitalization, increase patient and family satisfaction—all while not having a negative impact on patient outcome. In this sense, these units offer a very good cost-effectiveness ratio when used to care for patients who need specialized respiratory treatments.[23]

Fortunately, respiratory medicine adopted NIV techniques early, as shown by the many important publications on NIV authored by pneumologists. Therefore, hospital specialists in this field are highly familiar with NIV modalities and know how and when to use them. Nevertheless, human resources and spaces appropriate for NIV are not usually available—unless, that is, an intermediate RICU is on hand.

RICU Admissions Criteria

The decision to admit a patient to an intermediate RICU should be made on an individual basis, with consideration for age, concomitant diseases, and the patient's wishes.

Patients with severe respiratory failure, those with a high probability of needing IMV, and those with other forms of severe organ failure should be considered candidates for ICU admission. On the other hand, patients with acute respiratory insufficiency that is not sufficiently severe to warrant RICU admission can be admitted to a conventional ward. Patients who meet the following criteria should be considered candidates for RICU admission:

1. Patients transferring out of an ICU after stabilization who continue to need IMV after unsuccessful attempts at disconnection and patients who are difficult to wean, whether from NIV or IMV through a tracheostomy, are candidates for attempts to make progress with weaning or to titrate domiciliary ventilation. Patients should be conscious, hemodynamically stable, without signs of sepsis, have stable renal function and no cardiac arrhythmia or uncontrolled bleeding.

2. Patients transferring from an ICU after stabilization of a severe clinical situation or after prolonged IMV who need special nursing and/or physical therapy as an intermediate step before conventional hospitalization.

3. Use of NIV to treat acute or exacerbated chronic respiratory insufficiency.

4. Severe respiratory insufficiency that, although not requiring ventilatory support, makes a patient a candidate for noninvasive monitoring.

5. Patients after chest surgery involving pneumonectomy or surgery likely to cause a substantial reduction in postoperative lung function; patients with significant concurrent disease or who are more than 70 years old; and patients with important medical respiratory complications that arise after an operation. The previously mentioned criteria that would make such patients candidates for ICU admission should be ruled out.

6. Patients with life-threatening hemoptysis.

Intermediate RICU Location and Infrastructure

Currently there are no guidelines or standards describing the best placement, configuration or make-up of RICUs.[15,21,22,24] Because admitted patients have respiratory diseases and the main treatment is NIV,[24,25] the responsible physicians should be pneumologists and the support staff should come from a pneumology department, in the same way that coronary care units are staffed by cardiology departments.

Various locations have been proposed for hospital RICUs[22]:

1. Independent location. This model has the advantage of greater operating independence and adequate support for numerous patients, given that mixed cases will be better managed. The unit should have good access to the respiratory medicine department and/or the ICU. The main disadvantage of this model is loss of efficiency if the RICU is small or if large units have low occupancy. For RICUs following this model staff and space use is less integrated and hence less flexible, possibly leading to higher costs.

2. Parallel model. Locating an intermediate RICU adjacent to an ICU offers greater privacy for the RICU patient and allows for greater flexibility both in terms of team availability and rotation of staff between the 2 units. The main disadvantage is low occupancy for large RICUs.

3. Integrated model. A RICU that forms a part of the ICU or a pneumology ward, within a more or less specifically dedicated space, offers the advantage of continuity of patient care within the same department or unit and facilitates transfers when a patient's condition improves or worsens. This arrangement also offers integration of medical, nursing, physical therapy, auxiliary, and administrative personnel. A disadvantage is that workloads are highly variable in terms of complexity, calling for adjustments in nursing assignments. Other constraints that can arise are high costs for equipment per bed and for staff training. A variation of this last model would be a RICU that is adjacent to and functionally integrated with a sleep laboratory. Such spaces have resources with which to monitor breathing that are not normally used during the day. Because intermediate RICUs specialize in NIV, these spaces can be used as a day hospital for initiating home ventilation in certain chronically ill patients and for monitoring chronically ventilated patients to diagnose and solve problems that arise during home respirator therapy. Some monitoring resources available in sleep laboratories can also be used for patients admitted to RICUs.[21] This model facilitates the integration of NIV for acute conditions and for home respirator titration.

Although integrating an intermediate RICU into a pneumology ward is the usual pattern,[24] such placement will depend on a hospital's characteristics.

Physical Structure and Size

The area available per bed should be at least twice that used on a conventional hospital ward.[21,26] Thus, an open structure (without fixed partitions) in which beds are watched from a central nursing station, as is used in most ICUs, would provide the greatest ease of movement, better lines of vision, and allow for better care than would a closed structure (with partitions). However, partitions give more privacy to patients and family members. It is not in vain that one of the advantages of the RICU over the ICU is greater contact between patient and family.[27] If it is decided to have partitions, they should allow a constant view of the patient from the nursing station, whether direct (with partitions partly glazed) or by closed circuit television and audio contact. Because some patients need wheelchairs, sufficient space to maneuver them must be provided.

The number of beds in the unit should be adjusted to the needs of the area served by the hospital. It should be borne in mind that the number of patients who are candidates for NIV or noninvasive monitoring varies from one season of the year to another. NIV can also be carried out on a pneumology ward or in the ICU, depending on the severity of the patient's condition.[8,21] Small units (3 beds) lose part of the savings on staff and infrastructure in comparison with the costs of a conventional ICU.[22] The increased cost for a small unit can be alleviated by integrating the RICU into the respiratory medicine ward. Because NIV has proven useful for acute respiratory insufficiency in immunosuppressed patients,[28] it can be useful to have the means with which to isolate a patient on the RICU.

A RICU needs more electrical and gas (oxygen and compressed air) outlets and more of such equipment and furnishings as aspirators, monitor supports, respirators, or drip poles than are found on conventional wards. A specific system for grouping these elements at the head of each bed would be desirable.

The nursing station should be a structure that allows direct supervision of patients as well as provides information coming from physiological monitors. Office space and another room for administrative functions are also needed.[29] Other necessary spaces are medical offices, a secretary's office, a drug dispensary, a storeroom, and filing space—all of which can be shared if an integrated model is chosen.

Staff

Intermediate RICUs must be staffed by interdisciplinary teams. The supervisor should be a pneumologist and there should also be a supervising or coordinating nurse. One physician should be available for every 6 patients.[30] A doctor does not need to be on the intermediate RICU premises 24 hours a day but a physician on call should be present inside the hospital.[22,24] Generally speaking, it is possible to combine the afternoon and night shifts with those of the pneumology department. One staff nurse should be provided for a maximum of 4 patients on every shift,[21] 24 hours a day. Likewise, physical therapy staff will be needed. The recommended ratio is 1 therapist for every 6 beds, ideally for both morning and afternoon shifts. The nursing and physical therapy staff should be experienced with ventilator management and with outlets for oxygen therapy, placement of masks, and management of patients with severe respiratory insufficiency. It is also important to have nurses and other assistants on staff, particularly to help transfer and reposition patients.

Infrastructure, Furnishings, Equipment, and Supplies

The material needed for a RICU depends on many factors, among them the specific characteristics of each hospital. Roughly speaking, the requirements can be grouped as follows:

1. Infrastructure and furnishings.
2. Diagnostic and monitoring equipment.
3. Respiratory therapy equipment.
4. Equipment for patients after thoracic surgery.

Infrastructure and Furnishings

It is advisable to have a nursing station where all documents, including patient charts, can be kept and which is equipped with at least 1 computer. Trolleys for treatments, hygiene, and dispensing unit doses of drugs should be on hand. Trolleys with tracheal intubation sets and cardiopulmonary resuscitators should also be available. The resuscitation cart should also contain medications needed for emergencies. Beds should ideally have electric motors for changing positions. Mattresses for preventing bedsores should be used. Rooms should contain the following:

1. Rails alongside the bed for hanging disposable material needed for patient care.
2. Wall sockets for oxygen and pressurized air as well as for suction. At least 2 oxygen and pressurized air outlets are needed and 3 aspirators per patient. Suction connectors should lead to aspirators and systems for pleural drainage and the corresponding disposable material should be in stock. A manual reanimation bag (AMBU bag) should be available.
3. A bell or intercom for calling the nurse should be at each bed.
4. A table and a telephone with an outside line should be at the bedside.
5. Armchairs should be on hand, preferably adjustable ones, to allow patients to sit up if they can.

At least one pulley should be available to lift patients from beds, and bathrooms should be free of architectural barriers. A sufficient number of intravenous infusion and parenteral nutrition pumps should be stocked.

Diagnostic and Monitoring Equipment

Invasive monitoring is usually confined to the ICU whereas noninvasive techniques are used in the intermediate RICU. Monitoring devices that are essential for NIV are the pulse oximeter and arterial blood gas analyzers for use after starting ventilation or after respiratory parameters are reset.[25] Respiratory rate is another essential parameter to measure.[31] Monitoring of continuous electrocardiographic signals and noninvasive blood pressure is also desirable, as is vigilance of ventilator pressure and flow in patients on respirators.

Besides NIV, end-expiratory pressure by capnography, transcutaneous PCO_2, ventilatory pattern, maximum inspiratory pressure, neuromuscular activation by airway occlusion pressure, dynamic lung volumes, and peak flow are measurements to plan for.[19] Other more specialized parameters that can be monitored are transdiaphragmatic pressure, indirect calorimetry, plethysmography of respiratory impedance, and electromyography of the diaphragm and/or of other respiratory muscles.

Respirators and Supplies for Respiratory Therapies

Given that providing NIV is a main reason for creating an intermediate RICU, both volumetric and pressure cycled ventilators are needed. Among other features, devices should have an internal battery and/or an external one to facilitate patient transport. Devices for continuous positive airway pressure (CPAP) should also be available. Likewise all disposable material needed for NIV must be stocked:

1. *Full sets of tubing.* Exhaler ports are needed for respirators without a separate circuit for inhalation and exhalation. Intermediate RICUs should also have bacterial filters and connectors for oxygen for use when a respirator does not use pressurized oxygen.
2. *Masks.* Nasal interfaces, face masks covering both nose and mouth, and total face masks of different sizes and shapes that will adapt to different facial contours are needed, as are straps and harnesses for fixing the interface to the head. It may be necessary to fabricate bespoke masks, especially for patients requiring ventilation at home.

Because a considerable number of patients need tracheal intubation and IMV, at least 1 ventilator of this type should be available for patients waiting for transfer to an ICU. As mentioned in the previous section, disposable material consisting of tubing sets, endotracheal tubes, etc, must be stocked.

To care for patients with tracheostomies, the unit will need tubes of various sizes with an inflatable balloon or cuff inside, fenestrated to allow phonation or not, as well as metal cannulas for patients who do not need respirators. Other supplies for use in tracheostomized patients are obturator/dilators, brushes for cleaning inner cannulas, or phonatory valves.

Humidification is another important aspect of respirator therapy. Humidifiers generally take hot water, although heat and moisture exchange systems are appropriate for tracheostomized patients. Aerosol therapy also requires accessories. Nebulizers may be pneumatic, for generating large particles to be deposited in the bronchi, or ultrasonic, for creating smaller particles that must reach the lung parenchyma.

Equipment for Thoracic Surgery Patients

Specific equipment for thoracic surgery patients include pleural drains and systems to seal and aspirate the pleural cavity. Such systems may be open or closed.

Interaction With Other Departments or Units

ICUs

Population aging and the consequent risk of chronic illness, along with greater understanding of the pathophysiology of many processes, have meant improvements in therapeutic effectiveness. The ratio of ICU beds available to the number needed is therefore increasingly inadequate.[18] If we remember that the objective of ICUs should be to provide high quality care for patients who benefit from it, it should be clear that intermediate RICUs and ICUs should complement each other. It was suggested some time ago that intermediate RICUs should optimize our use of health care resources by lowering the number of admissions to ICUs, which are already overloaded, without affecting quality of care.[6] This assumption is based on the fact that around 40% of ICU patients do not receive intensive care—specifically IMV—and it is therefore believed that such patients would benefit from RICU hospitalization, above all if they have respiratory failure resulting from pulmonary disease. These patients, when treated with NIV or CPAP, receive more efficient care in a RICU with no loss of quality.[21] Thus, more ICU beds become available for patients with multiorgan failure or need for endotracheal intubation. Consistent with this, the closure of an intermediate care area has been reported to increase the rate of ICU utilization by less critically ill patients as measured by the Acute Physiology and Chronic Health (APACHE II) score.[20]

Chronically ill patients who have recovered from an exacerbation but who still need nursing or monitoring can also benefit from intermediate RICUs, as can individuals who are difficult to wean from the ventilator once the most difficult phase has been accomplished. Because such care can not be provided easily on a conventional ward, ICU discharge is often unnecessarily delayed.[21]

In summary, there are certain circumstances in which ICUs can benefit when care is provided in intermediate RICUs, as follows:

1. Intermediate RICU acceptance of patients with exacerbation of chronic respiratory disease,[32] particularly of COPD patients requiring NIV.

2. RICU handling of acute respiratory failure or patients with recurring exacerbations of chronic respiratory insufficiency who have required prolonged ICU stays for ventilation once the acute phase is over.

3. RICU admission of neuromuscular disease patients requiring titration of NIV or in advanced stages of these diseases when a tracheostomy is needed for IMV.

4. RICU handling of weaning difficulties, when NIV will provide a benefit.

5. RICU management of complex diseases in those discharged from an ICU who will benefit from the superior monitoring available in a step-down RICU in comparison with the limited vigilance possible on a general ward. (It is possible to identify patients at greater risk, and mortality in this subgroup can be reduced.[5,32])

6. Greater homogeneity of the case mix in ICUs, which would not receive admissions of patients below a certain level of severity (assessed by the Simplified Acute Physiology Score or the APACHE II), because such admissions would go to an intermediate RICU.[22]

7. Another advantage of RICUs for management of such patients is the greater privacy and comfort afforded there in comparison with the conditions possible in ICUs. This provides a more normal quality of life and more family contact.

Thoracic Surgery Departments

Opening an intermediate RICU is always beneficial for thoracic surgery departments because both the nurse-to-patient ratio and the range of noninvasive monitoring will be more favorable. Surgical patients can be discharged earlier from ICUs or postoperative recovery areas to RICUs once extubated and hemodynamically stable. Spending 24 to 48 hours in a RICU facilitates stabilization, thanks to the use of respiratory physical therapy and, in many cases, NIV. Intermediate RICUs are even more effective after surgery on the upper airways, as the ICU stay for such patients can be cut short without creating problems. RICUs are also useful for performing tracheostomies for neuromuscular patients and for laser procedures to correct tracheal stenosis. Moreover, they help bring pulmonary physicians and chest surgeons together to share the hospital facilities of the intermediate RICU.

Other Departments

Intermediate RICUs can be useful to the departments of otorhinolaryngology and internal medicine. Even the respiratory medicine department itself can benefit given that the use of NIV and noninvasive monitoring, along with the better nurse-to-patient ratio, mean that RICUs can be used as a step down from the ICU to the ward for respiratory patients who no longer require intensive care but who need careful monitoring that would be unavailable on a ward.[33] Mortality is said to decrease on hospital wards after a RICU opens.[34] RICUs have also contributed to reducing readmissions to ICUs.[35] Likewise, the usefulness of spending a few days in a RICU after an ICU stay has been reported for patients who have undergone surgery to correct obesity, for those with obstructive sleep apnea syndromes that often accompany obesity, for those needing upper airway care, and for the prevention of decubitus ulcers.[36]

Conclusions

Intermediate RICUs are the present and future of pulmonology and should be part of the facilities available at respiratory medicine departments of teaching hospitals. Having such a RICU means that pulmonary physicians must always be on call and that they should be adequately trained in caring for the critically ill respiratory patient. NIV must underlie the rationale for these units. The process through which intermediate RICUs are introduced should go hand in hand with a new residency training curriculum. Interactions with thoracic surgery departments are necessary for finding a balance between cost and effectiveness of these units.

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